

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Image Problem Mailbox.**

(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. AU 199921309 B2
(10) Patent No. 754297

(54) Title
Electromechanical cylinder lock

(51)⁷ International Patent Classification(s)
E05B 019/00 E05B 029/10
E05B 019/02 E05B 047/00
E05B 029/00 E05B 047/06

(21) Application No: 199921309

(22) Application Date: 1999.03.19

(30) Priority Data

(31) Number	(32) Date	(33) Country
980634	1998.03.20	FI
981197	1998.05.29	FI

(43) Publication Date : 1999.09.30

(43) Publication Journal Date : 1999.09.30

(44) Accepted Journal Date : 2002.11.14

(71) Applicant(s)
Abloy Oy

(72) Inventor(s)
Oiva Hurskainen; Hannu Sivonen

(74) Agent/Attorney
CALLINAN LAWRIE, Private Bag 7, KEW VIC 3101

(56) Related Art
FR 2687426
EP 528513

ABSTRACT

Electromechanical Cylinder Lock

An electromechanical cylinder lock including a lock body (1) and, inside thereof, a turnable lock cylinder (2) and a locking mechanism comprising locking means which normally prevent turning of the lock cylinder (2) with regard to the lock body (1) and which can be moved by means of a key (7) of the lock into a releasing position allowing turning of the lock cylinder (2), whereby a key (7) for the lock includes means (11) for transmitting an electronic code and the lock correspondingly includes means (13,14) for receiving and identifying the code of the key so that, on identifying a correct code, the receiving and identifying means (13,14) are arranged to enable mechanical opening of the lock by means of the key (7). The lock includes at least one locking disc (9,9',9") with a key opening (9b,9',9b") which is so designed that turning of the key does not directly act mechanically on the locking disc (9,9',9"). The lock also includes coupling means for coupling the at least one locking disc (9,9',9") to the turning movement of the key. In addition the lock is provided with electric operating means (17,17',17") activated by means of the electronic code from the key and which in its active state controls the coupling means so that the at least one locking disc (9,9',9") turns with the key into a position required for the opening of the locking mechanism.

(With Figure 1)

AUSTRALIA
PATENTS ACT 1990

COMPLETE SPECIFICATION

FOR A STANDARD PATENT

ORIGINAL

TO BE COMPLETED BY APPLICANT

Name of Applicant: ABLOY OY.

Actual Inventor(s): Oiva Hurskainen, Hannu Sivonen

Address for Service: CALLINAN LAWRIE, 711 High Street, Kew, 3101, Victoria, Australia

Invention Title: "ELECTROMECHANICAL CYLINDER LOCK"

The following statement is a full description of this invention, including the best method of performing it known to me:-

This invention relates to an electromechanical cylinder lock arrangement.

As is well known, the operation of a cylinder lock mechanism can be controlled by means of an electronic code supplied from a key. For this purpose the lock is provided
5 with a blocking member or the like which prevents normal use of the key. When the code supplied from the key is identified as being correct, control logic associated with the lock causes the blocking member to move into a position allowing turning of the locking mechanism and, thus, opening of the lock. However, arranging a blocking member in the lock body and guiding its movements requires space and often also a modification in the
10 construction of the lock mechanism. A solenoid of sufficient power and a power supply therefor are required to provide the necessary movement of the blocking member which makes the construction more complicated and increases its cost.

An aim of the present invention is to provide a novel electromechanical cylinder
15 lock arrangement in which the control of members of the lock mechanism, as a consequence of an identification of an electronic code supplied from the key of the lock, is provided by an arrangement which is advantageous as to its requirement of space and costs and entails as little change to the actual locking mechanism as possible. A further aim of the invention is to create a cylinder lock in which the members of a selected locking
20 mechanism can be utilized as blocking members.

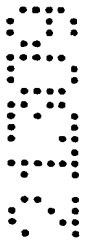
According to one aspect of the present invention there is provided an electromechanical cylinder lock arrangement a cylinder lock arrangement including an electromechanical cylinder lock and a key therefor, the lock including a lock body and,
25 inside the lock body, a turnable lock cylinder and a locking mechanism including locking means which normally prevent turning of the lock cylinder relative to the lock body and which is adapted to be moved by means of said key into a releasing position allowing turning of the lock cylinder relative to the lock body, whereby said key includes means for transmitting an electronic code and the lock correspondingly includes means for receiving and identifying the code of the key so that, on identifying a correct code, said code
30 receiving and identifying means allow mechanical opening of the lock by means of the key, wherein the lock further includes at least one locking disc with a key opening which is so designed that turning of the key does not directly act mechanically on the locking disc; coupling means for coupling said at least one locking disc to the turning movement of the
35 key; and electric operating means activated by means of the electronic code from the key and which, in the active state, control said coupling means so that said at least one locking disc turns with the key into a position required for the opening of the locking mechanism.



According to a further aspect of the present invention there is provided an electromechanical cylinder lock including a lock body and, inside the lock body, a turnable lock cylinder and a locking mechanism including locking means which normally prevent
5 turning of the lock cylinder relative to the lock body and which is adapted to be moved by means of a key of the lock into a releasing position allowing turning of the lock cylinder relative to the lock body, whereby a key for the lock includes means for transmitting an electronic code and the lock correspondingly includes means for receiving and identifying
10 the code of the key so that, on identifying a correct code, said code receiving and identifying means allow mechanical opening of the lock by means of the key, wherein the lock further includes at least one locking disc with a key opening which is so designed that turning of the key does not directly act mechanically on the locking disc, coupling means
15 for coupling said at least one locking disc to the turning movement of the key; and electric operating means activated by means of the electronic code from the key and which, in the active state, control said coupling means so that said at least one locking disc turns with the key into a position required for the opening of the locking mechanism.

Thus with a lock arrangement according to the invention, turning of the at least one locking disc takes

20



place only when a correct key code is identified and makes use of a coupling arrangement controlled separately by electric operating means. If an erroneous code is detected, the at least one "special" locking disc is not turned at all but this does not prevent turning of the key. In this case, for example with a cylinder lock provided with a locking mechanism having turnable locking discs, the conventional locking bar of the lock, together with the special locking disc(s), prevent the lock mechanism from opening even if operated by a key having the correct mechanical opening configuration or combination.

Advantageously the lock body is provided with a control unit which turns with the key on turning of the latter and on which said electric operating means are arranged. Suitably the control unit is provided with a key channel the cross-section of which corresponds to the cross-sectional profile of a shank part of the key of the lock. In addition the control unit may, with advantage, include said means for receiving and identifying the key code.

In order to provide a relatively simple construction, the key of the lock is provided with a power source and first electric contact means. In this case the control unit includes second electric contact means which are arranged, in cooperation with the first electric contact means and after identification of a correct electronic key code, to connect current from the power source in the key to said electric operating means. The second electric contact means of the control unit are conveniently located inside the key channel.

In order to secure undisturbed operation for the said at least one special locking disc the range of angular turning of the control unit and said at least one locking disc is limited with regard to the lock cylinder, preferably so that it corresponds at most to the selecting movement for the lock mechanism. In addition the control unit may be provided with a protrusion or like member which acts on said

locking disc and which is arranged to return the locking disc together with the control unit and the key to their initial positions. Since the return of the locking disc is, in this case, carried out under positive guidance, the power supply can be disconnected immediately after opening of the lock mechanism to save on battery power.

In an advantageous embodiment of the invention the electric operating means comprise electromagnetic means serving as said coupling means and the at least one locking disc is of ferromagnetic material and is located in the immediate vicinity of the control unit. Thus in this case, the turning of the at least one locking disc is achieved by a magnetic force created by the electromagnetic means so that a separate blocking member is not required, which is of advantage from the viewpoints of simplicity of construction and utilization of space. The electric current required for this kind of electric control is also relatively small in comparison with conventional solutions.

In an alternative embodiment of the invention the electric operating means may include coupling means operated by an electromagnet or the like. The coupling means is movable from a free, non-coupling position into a coupling position in which it is arranged to mechanically engage the at least one locking disc so that, when the control unit is turned by means of the key, the at least one locking disc turns together with the control unit.

In a further embodiment of the invention the at least one locking disc may be provided with a spring-loaded coupling member which is movable transversally with regard to the turning movement of the locking disc between two end positions in which it protrudes from said locking disc. In this case the electric operating means can with advantage be arranged to control the movement of the coupling member for controlling the turning of the said locking disc(s). In order to provide the necessary control, the electric operating means comprises an actuating member which is

operated by an electromagnet or the like and which is turnable between two turning positions so that in one of its turning positions the actuating member is movable in its axial direction, whereby the actuating member is arranged, in cooperating with the coupling member, to control turning of the locking disc(s). In this case the control unit, which turns continuously with the key, conveniently includes a coupling recess or the like for the coupling member. The coupling member tries to enter the coupling recess, urged by a spring, and is arranged at the position of the actuating member.

At an initial position corresponding to the insertion position of the key, the coupling member is located at a distance of a certain turning angle, for instance about 45° , from the coupling recess so that the coupling member and the coupling recess are opposite to each other when the key is turned in the lock from its initial position through said turning angle. In addition the lock may include a guiding disc which is located beside the at least one locking disc on the side opposite to the control unit. The guiding disc is non-turnably connected to the lock cylinder and comprises a coupling recess into which the coupling member is pressed against the force of an associated spring in the initial position of the key thereby preventing turning of the locking disc(s). In this embodiment the at least one locking disc is not turned at all unless a correct electronic code is supplied to the lock to control the coupling means so that it connects with the locking disc(s) and turns into a position required for opening of the locking mechanism. Since in this case coupling cannot be accomplished in the initial position of the locking members, possible manipulation of the coupling member can be prevented when the key is not inserted in the lock.

The invention can with advantage be applied to a cylinder lock with so-called turnable or rotatable locking discs. In this case the lock is provided with a set of locking discs mechanically turnable by means of the key of

the lock. The locking discs are located inside the lock cylinder and are each provided with a peripheral notch determining the opening combination of the lock. The locking means comprise additionally a locking bar which, in its locking position, together with the locking discs prevent turning of the lock cylinder relative to the lock body and which is movable into a releasing position allowing said turning when the locking discs are first turned by means of the key into positions required by the opening combination. In this case the control unit is with advantage located inside the lock cylinder and includes a groove corresponding to the peripheral notches of the locking discs for the locking bar of the lock. With such a construction the basic functions and components of a conventional mechanical cylinder lock construction with locking discs can be utilized.

The invention can also be utilized in the case where the locking means determining the turning of the lock cylinder with regard to the lock body comprises a pin tumbler mechanism known as such. In this case separate means for blocking the turning of the lock cylinder may be arranged for the special locking disc or alternatively side bar arrangements utilized in many pin tumbler mechanisms for providing additional security may be availed of.

Embodiments of the invention will now be described, by way of example only, with particular reference to the accompanying drawings, in which:

Figure 1 is an exploded view of one embodiment of an electromechanical cylinder lock arrangement according to the invention;

Figure 2 is a block diagram illustrating schematically operational principles of an electric part of the arrangement shown in Figure 1;

Figure 3 is an enlarged view of an alternative embodiment of electric operating means for inclusion in the cylinder lock arrangement of Figure 1;

5 Figure 4 is an axial sectional view of another embodiment of a cylinder lock arrangement according to the invention, the locking members being shown in initial positions corresponding to the insertion position of the key;

10 Figure 5 is a sectional view taken on the line V-V of Figure 4;

Figure 6 is a sectional view taken on the line VI-VI of Figure 4;

Figure 7 is an enlarged sectional view taken on the line VII-VII of Figure 4;

15 Figure 8 is an axial sectional view of the embodiment of Figure 4, taken at the position of the locking bar of the lock, after the key of the lock has been turned about 45° but without the correct electric code having been supplied;

20 Figure 9 is a sectional view taken on the line IX-IX of Figure 8;

Figure 10 is an enlarged sectional view taken on the line X-X of Figure 9;

25 Figure 11 is an axial sectional view of the embodiment of Figure 4, taken at the position of the locking bar of the lock, after the key of the lock has been turned about 45° but with the correct electric code having been supplied; and

30 Figure 12 is an enlarged sectional view taken on the line XII-XII of Figure 9 with the lock parts in an

operating position corresponding to the situation of Figure 11.

In the drawings 1 indicates a lock body of a cylinder lock. A turnable lock cylinder 2 is arranged inside the lock body 1 and encloses a set of locking discs 3, each provided with a peripheral notch 3a, and intermediate discs 4 separating the locking discs from each other. The lock mechanism also includes a locking bar 5 which, in a locking position, is located partly in a groove 1a in the inner surface of the lock body 1 and partly in a slot 6 in the lock cylinder 2 (cf. Figure 6) and, together with the locking discs, prevents turning of the lock cylinder 2 relative to the lock body 1.

Installation of the lock cylinder 2 into the lock body 1 and installation of the whole cylinder lock at its place of application is achieved with the use of members 30 in a manner known as such.

As shown in Figure 1, the set of locking discs includes a "special" locking disc 9. In the embodiment of Figure 1, the locking disc 9 is of ferromagnetic material. The lock also includes inside the lock cylinder 2 a control unit 10 including electric operating means 17 (not shown in detail in Figure 1). On insertion and turning of a key 7 in the lock, the control unit turns together with the key.

The locking disc 9 has a peripheral notch 9a and an opening 9b for the key which is so designed that the disc 9 is not contacted by the key when the latter is inserted and turned whereby the locking disc 9 cannot be directly turned by means of the key. The control unit 10 is provided with a peripheral groove 10a corresponding to a normal peripheral notch of a locking disc and with a key channel 10b. The cross-section of the channel 10b corresponds to the cross-sectional profile of a shank 7a of the key exclusive of any combination surfaces determining the opening of the lock. The control unit 10 and locking disc 9 also include counter

surfaces 10c and 9c, respectively, which cooperate with guiding surfaces 2a of the lock cylinder 2 so that the angular turning range of the parts 9 and 10 relative to the lock cylinder 2 corresponds to the turning angle required for opening of the lock mechanism, typically about 90°. A protrusion 10d extending in an axial direction from the control unit acts on one of the counter surfaces 9c of the locking disc 9 and ensures that the locking disc 9 always returns to its initial position at the same time as the control unit 10 is turned with the key back to its initial position.

In the embodiment of Figure 1, the electric operating means 17 in the control unit 10 comprise electromagnetic means. When current is connected to the electromagnetic means a magnetic field is created simultaneously affecting the locking disc 9 and also causing, when the control unit 10 is turned, turning of the locking disc 9 together with the control unit 10 and the key 7. Thus with current connected and when the locking discs 3, the control unit 10 and, with it, the locking disc 9 of the lock are turned by means of the key of the lock into a position in which the peripheral notches 3a and 9a and the peripheral groove 10a form a uniform channel at the position of the slot 6, the locking bar 5 can enter this channel and the lock mechanism can be opened. On further turning of the key the turning movement can be transmitted through the lock cylinder as is required by a particular application. In order to lock the lock mechanism, the key is turned in the opposite direction, whereby the locking bar 5 moves back to its locking position preventing turning of the lock cylinder. In the application shown in the drawings, return of the locking discs 3 takes place by means of a separate returning bar 8. The operation of this basic mechanism is explained in detail in, for instance, US-A-5490405.

In practice a coil (not shown) may with advantage serve as the electromagnetic means of the control unit 10. When current passes through the windings of the coil, the

magnetic force so created ensures that the locking disc 9 is magnetically attached to the control unit 10 and turns together with the latter when the key is turned in the lock. On the other hand when there is no current in the coil, the locking disc 9 is not magnetically attached to the control unit 10 and does not turn together with the control unit 10 when the key is turned. The locking disc 9 is held stationary primarily due to frictional forces. However even if the locking disc 9 were able to turn slightly with the control unit 10, it would not result in opening of the lock mechanism since this requires the locking disc 9 to be turned through a full range of selection in order for the locking bar 5 to be released. Correspondingly when the key and, thus, also the control unit 10, are turned back to their initial positions, the protrusion 10d of the control unit ensures return of also the locking disc 9 to its initial position.

The lock and key include electronic parts of their own and, on the basis of their cooperation, determine when current is to be connected to the coil of the control unit 10 so that the cylinder lock mechanism can be opened by a key provided with the correct mechanical opening combination. This is illustrated schematically in Figure 2.

The key 7 is provided with an electronic part 11 comprising means for saving and transmitting an electronic code and a battery or some other suitable power source (not shown). In the embodiment shown the electronic code and electric current are fed from the key to the control unit 10 through first contact means 12 located in the key and corresponding second contact means 13 located in the key channel 10b. From the second contact means 13 the code is supplied to an electronic unit 14 in the lock where the received code is identified at 15 by comparison with a presaved code or codes. The second contact means 13 are not shown in Figure 1 and are schematically shown in Figure 2 but are conveniently located in a similar position to the contact means 13" shown in the embodiment of Figure 4.

On the occurrence of a correct code, connection of electric current to the electromagnetic means included in the electric operating means 17 is provided by means 16 whereby, at the same time, there is created a magnetic field affecting the locking disc 9. In this case the locking disc 9 will be turned with the control unit 10 until the current is disconnected, which would normally take place after the lock mechanism is relocked and the key is turned into its initial position and removed from the lock. Since, however, return of the locking disc 9 occurs under positive guidance under the influence of the protrusion 10d of the control unit 10, the supply of current can be disconnected immediately after opening of the lock mechanism in order to preserve battery power.

If the code supplied from the key is not correct, current is not connected to the electromagnetic means and, thus, no magnetic field is created to act on the locking disc 9, whereby turning of the key in the lock does not provide opening of the lock mechanism as described above. In addition to the second contact means 13 the above described electronic part 14 with its components can with advantage and in order to save space be located in the control unit 10.

The electronic code of the key can be transmitted or fed from the key to the lock by many different ways and techniques and, when necessary, independently of the current supply. This is true especially when the lock is provided with a power supply of its own. However, with the solution according to the embodiment shown in Figure 1, it is possible to accomplish a less complicated and a space saving construction for the cylinder lock.

By arranging for the control unit 10 and the locking disc 9 to be positioned, as shown, at one end of the set of discs, the supply of current and code may be arranged in a simple manner from the base part of the key shank 7a. However, in principle there is nothing to prevent the

location being at other parts along the key channel. Also more than one "special" locking disc 9 may be utilized, for instance located on either side of the control unit 10 or side by side.

5 In practice the control unit 10, which may take about 5 - 6 mm of the length of the key channel, and the locking disc 9 are a substitute for part of the conventional assembled set of locking discs, so that the total length of the set of discs is not increased. As a consequence the
10 number of mechanical opening combinations is correspondingly decreased. However, when the mechanical opening combinations available are combined with the numerous electronic codes, a multiple number of new key combinations can be obtained. This, together with the magnetic control
15 arrangement, increases essentially both the security of the lock mechanism and the key security.

In the embodiment of Figure 3, the control unit 10' and the locking disc 9' with their mechanical members correspond analogously to the control unit 10 and the
20 locking disc 9 and their members shown in Figure 1. The embodiment of Figure 3 differs, however, from the embodiment of Figure 1 in that there is provided an electromagnet 18' controlling a coupling member 19 movable in axial directions depending on whether or not there is current in the
25 electromagnet. This, for its part, depends on the code fed or transmitted from the key. If the code is correct, the coupling member 19 moves, under the influence of the electromagnet 18', from the control unit 10' into a protruding position which engages in an opening 20 arranged
30 in the locking disc 9'. Thus when the control unit 10' is turned by the key of the lock the locking disc 9' is turned with it through the coupling member 19. Return of the coupling member 19 can be arranged in many alternative ways, for example by changing the polarity of the electromagnet,
35 by additionally utilizing a permanent magnet or by using fully mechanical arrangements. In other respects the operation of this embodiment corresponds substantially to

that of the embodiment of Figure 1. For example return of the locking disc 9' occurs under positive guidance under the influence of a protrusion 10d' of the control unit 10'.

Since the coupling of the embodiment of Figure 3 is
5 mechanical, the locking disc 9' need not be made of ferromagnetic material. The actual coupling member 19 may in practice be the anchor member of the electromagnet 18', which is relatively small in size and mass. Hence, no great power is required for its movement, whereby the solenoid to
10 be used can be small which is advantageous as to its costs and economy of use of electric power.

The embodiment of Figures 4 to 12 differs from the
embodiments described above in that movable coupling means,
controlled by electric operating means 17" and by means of
15 which the special locking disc 9" can be turned into an opening position of the lock mechanism, are located both in the control unit 10" and in the locking disc 9". Another difference is that coupling is accomplished only when the key has already been turned through a certain angle, for
20 instance about 45°, provided, of course, that the correct electronic code is fed into the lock.

In the arrangement shown in Figures 4 to 12, the lock
body 1 includes, at the key insertion end of the key
channel, an element 21 which turns continuously with the
25 key. The element 21 defines the profile of keys compatible with the lock and also serves as a deterrent to drilling of the lock. Located radially outside the element 21 there is a guiding disc 22, which is non-turnably supported against the lock cylinder 2 and which supports and guides the
30 locking disc 9" which, thus, remains between the control unit 10" and the guiding disc 22.

In order to connect the locking disc 9" to the
turning movement of the key, the control unit 10" includes
an actuating member 25 which is controlled by an
35 electromagnet 18" included in electric operating means 17".

At the position of the actuating member 25 there is a coupling recess 24 in the control unit 10" which is provided with a bevelled guiding surface 24a. The actuating member 25 can be turned between two end positions by changing the polarity of the electromagnet 18" so that in one end position the actuating member 25 can be pressed against the force of a spring 26 entirely inside the control unit 10" as is apparent from Figure 10. For this purpose an inner end 25a of the actuating member 25 is suitably designed to be narrower. In addition the body unit of the electromagnet 18" is provided with limiting members 27 (cf. Figure 7) which determine the angular turning range of the actuating member 25, which is preferably 90° or less. Furthermore, the arrangement advantageously includes a permanent magnet 28, which keeps the actuating member 25 in one of its end positions corresponding to the initial position and thereby ensures that the actuating member cannot be affected by means of external magnetic fields or other disturbances, for instance shakes or vibrations.

The locking disc 9" for its part includes a through-going hole 9d" which encloses a coupling member 23 which can be pressed, against the force of a spring 29, so that it extends into a recess 22a in the guiding disc 22. In this position of the coupling member 23 the locking disc 9" cannot be turned (cf. Figures 8 and 10). As is apparent from Figure 5, in the initial position the coupling member 23 and the recess 22a are located at a turning angle of about 45° from the coupling recess 24 and the actuating member 25.

The operation of the embodiment of Figures 4 to 12 is as follows. In the initial position of the mechanism according to Figures 4 to 7, in which the key is inserted into the key channel of the lock (for clarity the key is not shown in these figures), the actuating member 25, urged by the spring 26, extends beyond the coupling recess 24 against the locking disc 9". Initially when the key is turned in the lock, the locking disc 9" remains at its initial

position, in which the coupling member 23 extends into the recess 22a in the guiding disc 22 pressed by the control unit 10" (this position is shown in Figure 10). After turning of the key about 45°, the coupling member 23 is located at the position of the coupling recess 24 and the actuating member 25. In the absence of a correct electric code the turning position of the actuating member 25 is not changed. Hence, the actuating member 25 prevents movement of the coupling member 23 into the coupling recess 24 and the locking disc 9" remains together with the guiding disc 22 in its position (cf. Figures 8 - 10) and the lock mechanism cannot be opened.

Figures 11 and 12 for their part show the operation when a correct electric code is fed into the lock. As a result of identifying the code a control command is provided which changes the polarity of the electromagnet 18". This results in the actuating member 25 being turned through 90° so that its inner end 25a is pressed by the coupling member 23, urged by the spring 29, against the force of the spring 26 into a position allowing the coupling member 23 to enter the coupling recess 24. At the same time the coupling member 23 is released from the recess 22a in the guiding disc 22. As a consequence, when the key is turned further, the locking disk 9" turns with it so that its peripheral notch 9a" (see Figures 6 and 9) is located at the position of the locking bar 5 (not shown) thereby allowing for its part opening of the lock mechanism.

In contrast to the embodiments of Figures 1 and 3, in this embodiment the return of the locking disc 9" does not require a separate protrusion 10d or 10d' to be arranged on the control unit 10", but the locking disc 9" turns under the influence of the coupling recess 24 and the coupling member 23 back to a position determined by the guiding surface 2a in the lock cylinder in which the coupling recess and coupling member are at the position of the recess 22a in the guiding disc 22. In this case, when the key is turned further, the coupling member 23 moves into the recess 22a

against the force of its spring 29 urged by the guiding surface 24a in the coupling recess 24 (cf. Figures 12 and 10) and prevents again turning of the locking disc 9" when the key is turned in the opening direction of the locking mechanism. At the same time the spring 26 urges the actuating member 25 out against the locking disc 9" and the actuating member 25 is turned back into the initial position according to Figure 4 due to the changed polarity of the electromagnet 18".

10 The operation of the actuating member 25 does not necessarily need a separate spring 26 since a corresponding operation can be accomplished through suitable design of the end 25a and of the counter surfaces in the body part cooperating therewith.

15 There are many alternative ways of providing a coupling for the special locking disc. One further way could be based on the embodiment of Figure 3 but modified according to the embodiment of Figures 4 to 12 so as to make use of an angular turning range of the special locking disc for releasing the lock mechanism to be less than the whole turning range of the key for selecting the opening combination. Then, at the initial position, the special locking disc would always be coupled to the control unit by means of a coupling member located in the control unit and, 25 for example, a permanent magnet located in the lock body or in a guiding disc or the like so as to be turnable together with it by means of the key. In the absence of a correct code, the special locking disc would be turned continuously beyond the correct turn for "releasing". On the other hand, 30 on the occurrence of a correct code, the electric operating means would be activated so as to disengage the coupling after a certain turning angle when the special locking disc is moved out of the effective magnetic field of the permanent magnet. Thereafter the locking disc could be 35 further moved a correct turning angle, i.e. less than the full range of turning, by means of an additional protrusion

arranged in the control unit so as to place it at the correct position for releasing the locking mechanism.

In addition to the lock mechanism shown in Figure 1, the invention may of course also be applied to a number of other types of cylinder lock mechanisms based on rotatable locking discs, for instance the conventional cylinder lock mechanism, which does not include a return bar 8, and in which return of the locking discs to their initial positions is accomplished directly by the key of the lock, as well as bi-directionally operable locking disc mechanisms.

In addition the invention may be applied to entirely different cylinder lock mechanisms such as so-called pin tumbler mechanisms. Since in this case the lock cylinder is not hollow in the same way, the control unit and the special locking disc should be located at the end of the cylinder barrel outside thereof. In addition a separate locking member arrangement is required for the special locking disc, for instance a member corresponding to the locking bar, which acts on both the control unit and on the special locking disc so that it does not allow turning of the lock cylinder and the control unit to the final end position as required by the application in each case without turning the special locking disc correspondingly a selected turning angle so as to make releasing of the locking bar possible. Hence also in this case the lock cannot be opened by a key provided merely with a correct mechanical opening combination, even if the lock cylinder could be turned somewhat. The lock can only be opened if a correct electronic key code is fed and, as a consequence thereof, power supply to the electromagnetic means in the control unit is connected, whereby the special locking disc turns with the key and the control unit into a position in which the locking bar or the like is released so as to allow further turning of the members.

Thus, the invention is not restricted to the embodiments shown, but several modifications are feasible within the scope of the attached claims.

- 5 Where the terms "comprise", "comprises", "comprised" or "comprising" are used in this specification, they are to be interpreted as specifying the presence of the stated features, integers, steps or components referred to, but not to preclude the presence or addition of one or more other feature, integer, step, component or group thereof.

5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
260
261
262
263
264
265
266
267
268
269
270
271
272
273
274
275
276
277
278
279
280
281
282
283
284
285
286
287
288
289
290
291
292
293
294
295
296
297
298
299
300
301
302
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338
339
340
341
342
343
344
345
346
347
348
349
350
351
352
353
354
355
356
357
358
359
360
361
362
363
364
365
366
367
368
369
370
371
372
373
374
375
376
377
378
379
380
381
382
383
384
385
386
387
388
389
390
391
392
393
394
395
396
397
398
399
400
401
402
403
404
405
406
407
408
409
410
411
412
413
414
415
416
417
418
419
420
421
422
423
424
425
426
427
428
429
430
431
432
433
434
435
436
437
438
439
440
441
442
443
444
445
446
447
448
449
450
451
452
453
454
455
456
457
458
459
460
461
462
463
464
465
466
467
468
469
470
471
472
473
474
475
476
477
478
479
480
481
482
483
484
485
486
487
488
489
490
491
492
493
494
495
496
497
498
499
500
501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534
535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563
564
565
566
567
568
569
570
571
572
573
574
575
576
577
578
579
580
581
582
583
584
585
586
587
588
589
590
591
592
593
594
595
596
597
598
599
600
601
602
603
604
605
606
607
608
609
610
611
612
613
614
615
616
617
618
619
620
621
622
623
624
625
626
627
628
629
630
631
632
633
634
635
636
637
638
639
640
641
642
643
644
645
646
647
648
649
650
651
652
653
654
655
656
657
658
659
660
661
662
663
664
665
666
667
668
669
670
671
672
673
674
675
676
677
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695
696
697
698
699
700
701
702
703
704
705
706
707
708
709
710
711
712
713
714
715
716
717
718
719
720
721
722
723
724
725
726
727
728
729
730
731
732
733
734
735
736
737
738
739
740
741
742
743
744
745
746
747
748
749
750
751
752
753
754
755
756
757
758
759
760
761
762
763
764
765
766
767
768
769
770
771
772
773
774
775
776
777
778
779
780
781
782
783
784
785
786
787
788
789
790
791
792
793
794
795
796
797
798
799
800
801
802
803
804
805
806
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
824
825
826
827
828
829
830
831
832
833
834
835
836
837
838
839
840
841
842
843
844
845
846
847
848
849
850
851
852
853
854
855
856
857
858
859
860
861
862
863
864
865
866
867
868
869
870
871
872
873
874
875
876
877
878
879
880
881
882
883
884
885
886
887
888
889
890
891
892
893
894
895
896
897
898
899
900
901
902
903
904
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
921
922
923
924
925
926
927
928
929
930
931
932
933
934
935
936
937
938
939
940
941
942
943
944
945
946
947
948
949
950
951
952
953
954
955
956
957
958
959
960
961
962
963
964
965
966
967
968
969
970
971
972
973
974
975
976
977
978
979
980
981
982
983
984
985
986
987
988
989
990
991
992
993
994
995
996
997
998
999
1000
1001
1002
1003
1004
1005
1006
1007
1008
1009
1010
1011
1012
1013
1014
1015
1016
1017
1018
1019
1020
1021
1022
1023
1024
1025
1026
1027
1028
1029
1030
1031
1032
1033
1034
1035
1036
1037
1038
1039
1040
1041
1042
1043
1044
1045
1046
1047
1048
1049
1050
1051
1052
1053
1054
1055
1056
1057
1058
1059
1060
1061
1062
1063
1064
1065
1066
1067
1068
1069
1070
1071
1072
1073
1074
1075
1076
1077
1078
1079
1080
1081
1082
1083
1084
1085
1086
1087
1088
1089
1090
1091
1092
1093
1094
1095
1096
1097
1098
1099
1100
1101
1102
1103
1104
1105
1106
1107
1108
1109
1110
1111
1112
1113
1114
1115
1116
1117
1118
1119
1120
1121
1122
1123
1124
1125
1126
1127
1128
1129
1130
1131
1132
1133
1134
1135
1136
1137
1138
1139
1140
1141
1142
1143
1144
1145
1146
1147
1148
1149
1150
1151
1152
1153
1154
1155
1156
1157
1158
1159
1160
1161
1162
1163
1164
1165
1166
1167
1168
1169
1170
1171
1172
1173
1174
1175
1176
1177
1178
1179
1180
1181
1182
1183
1184
1185
1186
1187
1188
1189
1190
1191
1192
1193
1194
1195
1196
1197
1198
1199
1200
1201
1202
1203
1204
1205
1206
1207
1208
1209
1210
1211
1212
1213
1214
1215
1216
1217
1218
1219
1220
1221
1222
1223
1224
1225
1226
1227
1228
1229
1230
1231
1232
1233
1234
1235
1236
1237
1238
1239
1240
1241
1242
1243
1244
1245
1246
1247
1248
1249
1250
1251
1252
1253
1254
1255
1256
1257
1258
1259
1260
1261
1262
1263
1264
1265
1266
1267
1268
1269
1270
1271
1272
1273
1274
1275
1276
1277
1278
1279
1280
1281
1282
1283
1284
1285
1286
1287
1288
1289
1290
1291
1292
1293
1294
1295
1296
1297
1298
1299
1300
1301
1302
1303
1304
1305
1306
1307
1308
1309
1310
1311
1312
1313
1314
1315
1316
1317
1318
1319
1320
1321
1322
1323
1324
1325
1326
1327
1328
1329
1330
1331
1332
1333
1334
1335
1336
1337
1338
1339
1340
1341
1342
1343
1344
1345
1346
1347
1348
1349
1350
1351
1352
1353
1354
1355
1356
1357
1358
1359
1360
1361
1362
1363
1364
1365
1366
1367
1368
1369
1370
1371
1372
1373
1374
1375
1376
1377
1378
1379
1380
1381
1382
1383
1384
1385
1386
1387
1388
1389
1390
1391
1392
1393
1394
1395
1396
1397
1398
1399
1400
1401
1402
1403
1404
1405
1406
1407
1408
1409
1410
1411
1412
1413
1414
1415
1416
1417
1418
1419
1420
1421
1422
1423
1424
1425
1426
1427
1428
1429
1430
1431
1432
1433
1434
1435
1436
1437
1438
1439
1440
1441
1442
1443
1444
1445
1446
1447
1448
1449
1450
1451
1452
1453
1454
1455
1456
1457
1458
1459
1460
1461
1462
1463
1464
1465
1466
1467
1468
1469
1470
1471
1472
1473
1474
1475
1476
1477
1478
1479
1480
1481
1482
1483
1484
1485
1486
1487
1488
1489
1490
1491
1492
1493
1494
1495
1496
1497
1498
1499
1500
1501
1502
1503
1504
1505
1506
1507
1508
1509
1510
1511
1512
1513
1514
1515
1516
1517
1518
1519
1520
1521
1522
1523
1524
1525
1526
1527
1528
1529
1530
1531
1532
1533
1534
1535
1536
1537
1538
1539
1540
1541
1542
1543
1544
1545
1546
1547
1548
1549
1550
1551
1552
1553
1554
1555
1556
1557
1558
1559
1560
1561
1562
1563
1564
1565
1566
1567
1568
1569
1570
1571
1572
1573
1574
1575
1576
1577
1578
1579
1580
1581
1582
1583
1584
1585
1586
1587
1588
1589
1590
1591
1592
1593
1594
1595
1596
1597
1598
1599
1600
1601
1602
1603
1604
1605
1606
1607
1608
1609
1610
1611
1612
1613
1614
1615
1616
1617
1618
1619
1620
1621
1622
1623
1624
1625
1626
1627
1628
1629
1630
1631
1632
1633
1634
1635
1636
1637
1638
1639
1640
1641
1642
1643
1644
1645
1646
1647
1648
1649
1650
1651
1652
1653
1654
1655
1656
1657
1658
1659
1660
1661
1662
1663
1664
1665
1666
1667
1668
1669
1670
1671
1672
1673
1674
1675
1676
1677
1678
1679
1680
1681
1682
1683
1684
1685
1686
1687
1688
1689
1690
1691
1692
1693
1694
1695
1696
1697
1698
1699
1700
1701
1702
1703
1704
1705
1706
1707
1708
1709
1710
1711
1712
1713
1714
1715
1716
1717
1718
1719
1720
1721
1722
1723
1724
1725
1726
1727
1728
1729
1730
1731
1732
1733
1734
1735
1736
1737
1738
1739
1740
1741
1742
1743
1744
1745
1746
1747
1748
1749
1750
1751
1752
1753
1754
1755
1756
1757
1758
1759
1760
1761
1762
1763
1764
1765
1766
1767
1768
1769
1770
1771
1772
1773
1774
1775
1776
1777
1778
1779
1780
1781
1782
1783
1784
1785
1786
1787
1788
1789
1790
1791
1792
1793
1794
1795
1796
1797
1798
1799
1800
1801
1802
1803
1804
1805
1806
1807
1808
1809
1810
1811
1812
1813
1814
1815
1816
1817
1818
1819
1820
1821
1822
1823
1824
1825
1826
1827
1828
1829
1830
1831
1832
1833
1834
1835
1836
1837
1838
1839
1840
1841
1842
1843
1844
1845
1846
1847
1848
1849
1850
1851
1852
1853
1854
1855
1856
1857
1858
1859
1860
1861
1862
1863
1864
1865
1866
1867
1868
1869
1870
1871
1872
1873
1874
1875
1876
1877
1878
1879
1880
1881
1882
1883
1884
1885
1886
1887
1888
1889
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
2046
2047
2048
2049
2050
2051
2052
2053
2054
2055
2056
2057
2058
2059
2060
2061
2062
2063
2064
2065
2066
2067
2068
2069
2070
2071
2072
2073
2074
2075
2076
2077
2078
2079
2080
2081
2082
2083
2084
2085
2086
2087
2088
2089
2090
2091
2092
2093
2094
2095
2096
2097
2098
2099
2100
2101
2102
2103
2104
2105
2106
2107
2108
2109
2110
2111
2112
2113
2114
2115
2116
2117
2118
2119
2120
2121
2122
2123
2124
2125
2126
2127
2128
2129
2130
2131
2132
2133
2134
2135
2136
2137
2138
2139
2140
2141
2142
2143
2144
2145
2146
2147
2148
2149
2150
2151
2152
2153
2154
2155
2156
2157
2158
2159
2160
2161
2162
2163
2164
2165
2166
2167
2168
2169
2170
2171
2172
2173
2174
2175
2176
2177
2178
2179
2180
2181
2182
2183
2184
2185
2186
2187
2188
2189
2190
2191
2192
2193
2194
2195
2196
2197
2198
2199
2200
2201
2202
2203
2204
2205
2206
2207
2208
2209
2210
2211
2212
22

The claims defining the invention are as follows:

1. A cylinder lock arrangement including an electromechanical cylinder lock and a key therefor, the lock including a lock body and, inside the lock body, a turnable lock
5 cylinder and a locking mechanism including locking means which normally prevent turning of the lock cylinder relative to the lock body and which is adapted to be moved by means of said key into a releasing position allowing turning of the lock cylinder relative to the lock body, whereby said key includes means for transmitting an electronic code and the lock correspondingly includes means for receiving and identifying the code of the key so
10 that, on identifying a correct code, said code receiving and identifying means allow mechanical opening of the lock by means of the key; wherein the lock further includes at least one locking disc with a key opening which is so designed that turning of the key does not directly act mechanically on the locking disc; coupling means for coupling said at least one locking disc to the turning movement of the key, and electric operating means
15 activated by means of the electronic code from the key and which, in the active state, control said coupling means so that said at least one locking disc turns with the key into a position required for the opening of the locking mechanism.
2. The cylinder lock arrangement according to claim 1, wherein the lock body is
20 provided with a control unit turnable continuously with the key and on which said electric operating means are arranged.
3. The cylinder lock arrangement according to claim 2, wherein the control unit is
25 provided with a key channel having a cross-section which corresponds to the cross-sectional profile of a shank part of said key, and wherein the control unit further includes said means for receiving and identifying the key code.
4. The cylinder lock arrangement according to claim 2 or claim 3, wherein said
30 key for the lock is provided with a power source and first electric contact means and wherein said control unit includes second electric contact means which are arranged to cooperate with said first electric contact means and, after identification of a correct electronic key code, to connect current from said power source to said electric operating means.
- 35 5. The cylinder lock arrangement according to claim 4, wherein the second electric contact means are located inside the key channel.
6. The cylinder lock arrangement according to any one of claims 2 to 5, wherein the turning range of the control unit and said at least one locking disc is limited with regard



to the lock cylinder.

7. The cylinder lock arrangement according to any one of claims 2 to 6, wherein the control unit is provided with protrusion means which acts on said locking disc and
5 which is arranged to return said locking disc together with the control unit and the key to the initial position of the locking mechanism.

8. The cylinder lock arrangement according to any one of claims 2 to 7, wherein said electric operating means includes electromagnetic means and wherein said at least one
10 locking disc includes ferromagnetic material and is located in the immediate vicinity of the control unit.

9. The cylinder lock arrangement according to any one of claims 2 to 7, wherein said electric operating means include coupling means operated by electromagnet means
15 and which is movable from a free, non-coupling position into a coupling position in which it is arranged to mechanically engage said locking disc so that, when the control unit is turned by means of the key, said locking disc turns together with the control unit.

20 10. The cylinder lock arrangement according to any one of claims 2 to 6, wherein said at least one locking disc is provided with a spring-loaded coupling member which is movable transversely with regard to the turning movement of the locking disc between two end positions in which it protrudes from said locking disc, and wherein said electric
operating means is arranged to control movement of said coupling member for controlling
25 turning of said locking disc.

11. The cylinder lock arrangement according to claim 10, wherein said electric operating means include an actuating member which is operated by electromagnet means
30 and is turnable between two angular positions so that in one of its angular positions the actuating member is movable in an axial direction, and wherein the actuating member is arranged in cooperation with said coupling member for controlling turning of said locking disc.

35 12. The cylinder lock arrangement according to claim 11, wherein said control unit includes a coupling recess towards which said coupling member is urged by a spring for entry into the coupling recess, and wherein said coupling recess is arranged at the position of said actuating member.



13. The cylinder lock arrangement according to claim 12, wherein at an initial position corresponding to the insertion position of the key, the coupling member is located at a distance of a certain turning angle from said coupling recess so that the coupling member and the coupling recess are opposite to each other when the key is turned in the lock from its initial position through said turning angle.

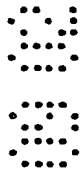
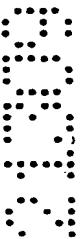
14. The cylinder lock arrangement according to claim 13, wherein said angle is about 45°.

15. The cylinder lock arrangement according to any one of claims 10 to 14, wherein the lock includes a guiding disc which is located beside said at least one locking disc on the opposite side with regard to the control unit, and wherein the guiding disc is non-turnably connected to the lock cylinder and includes a coupling recess into which the coupling member is pressed against the force of its spring in the initial position of the key thereby preventing turning of the locking disc.

16. The cylinder lock arrangement according to any one of claims 2 to 14, in which the lock cylinder of the lock includes an axial slot and a set of locking discs mechanically turnable by means of said key, said locking discs being located inside the lock cylinder and each being provided with a peripheral notch determining the opening combination of the lock, whereby the locking means further includes a locking bar which, in its locking position, together with the locking discs prevents turning of the lock cylinder with regard to the lock body and which is movable into a releasing position allowing said turning when the locking discs are first turned by means of the key into positions in which the peripheral notches thereof form a uniform channel at the position of the locking bar and said slot in the lock cylinder, wherein said control unit is located inside the lock cylinder and includes a groove corresponding to the peripheral notches of the locking discs for receiving the locking bar of the lock.

17. The cylinder lock arrangement according to any one of claims 1 to 9, wherein the locking means determining the turning of the lock cylinder with regard to the lock body include a pin-tumbler mechanism known as such.

18. An electromechanical cylinder lock including a lock body and, inside the lock body, a turnable lock cylinder and a locking mechanism including locking means which normally prevent turning of the lock cylinder relative to the lock body and which are adapted to be moved by means of a key of the lock into a releasing position allowing turning of the lock cylinder relative to the lock body, whereby a key for the lock includes means for transmitting an electronic code and the lock correspondingly includes means for



receiving and identifying the code of the key so that, on identifying a correct code, said code receiving and identifying means allow mechanical opening of the lock by means of the key, wherein the lock further includes at least one locking disc with a key opening which is so designed that turning of the key does not directly act mechanically on the locking disc, coupling means for coupling said at least one locking disc to the turning movement of the key; and electric operating means activated by means of the electronic code from the key and which, in the active state, control said coupling means so that said at least one locking disc turns with the key into a position required for the opening of the locking mechanism.

19. A cylinder lock arrangement as claimed in claim 1, substantially as described herein with reference to the accompanying drawings.

20. An electromechanical cylinder lock as claimed in claim 18, substantially as described herein with reference to the accompanying drawings.

DATED this 30th day of August, 2002

ABLOY OY

By their Patent Attorneys:

CALLINAN LAWRIE

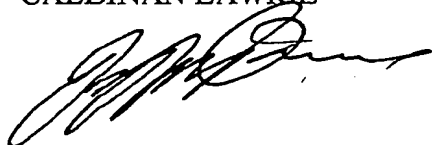


Fig. 1

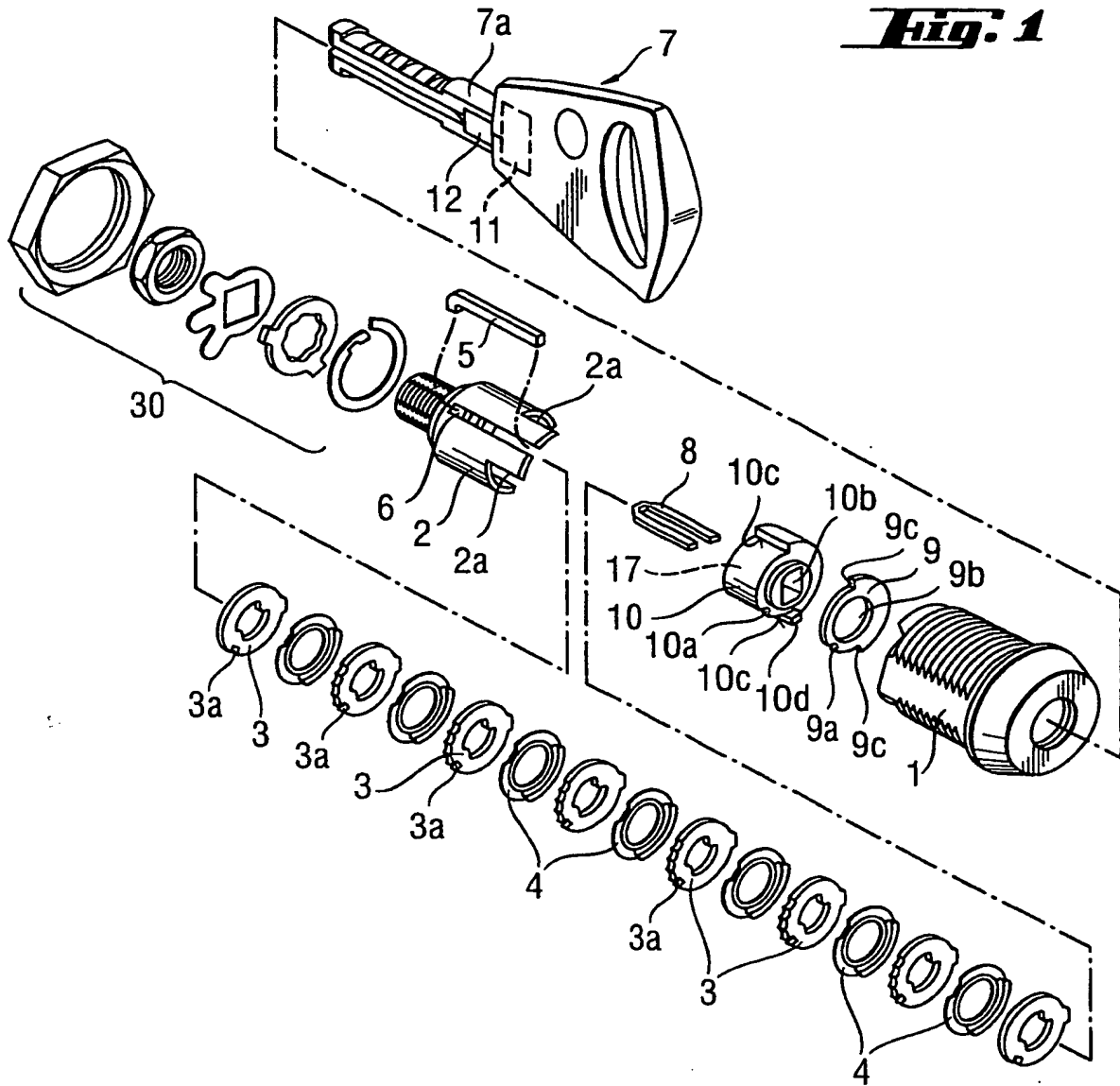


Fig. 2

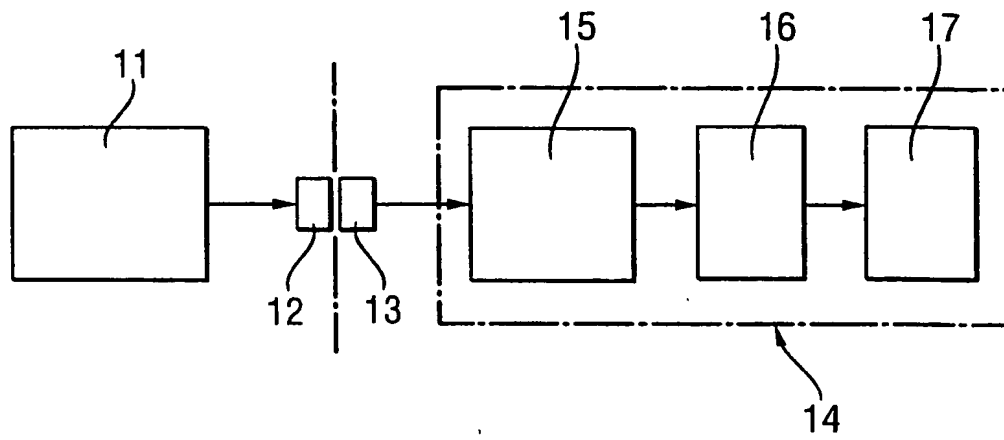


Fig. 3

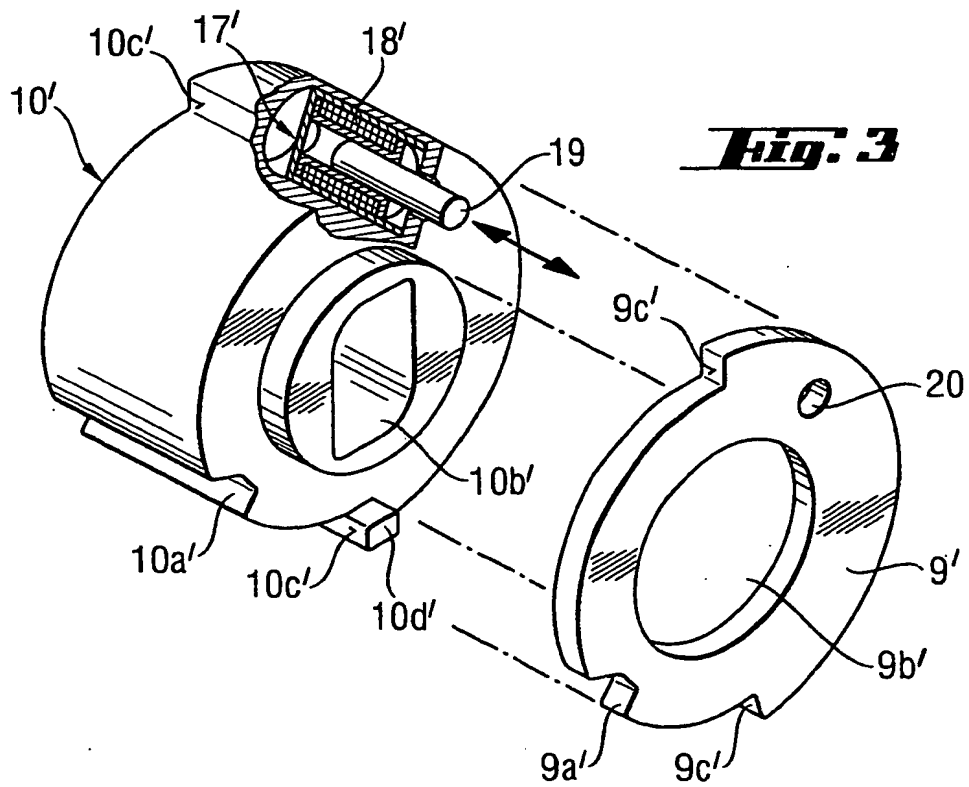


Fig. 4

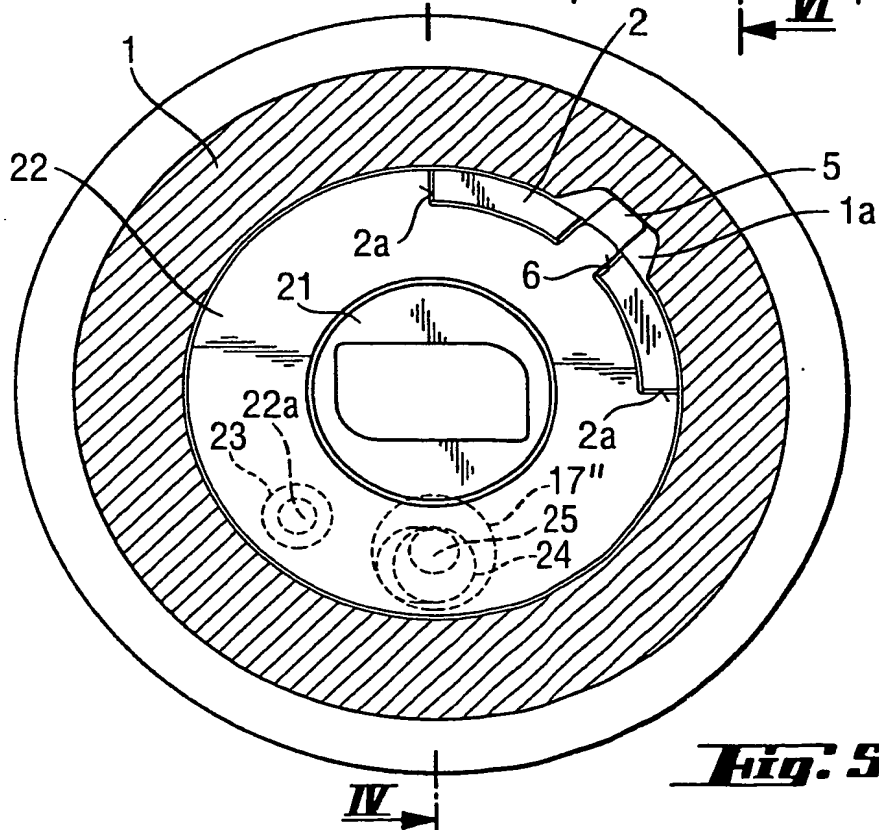
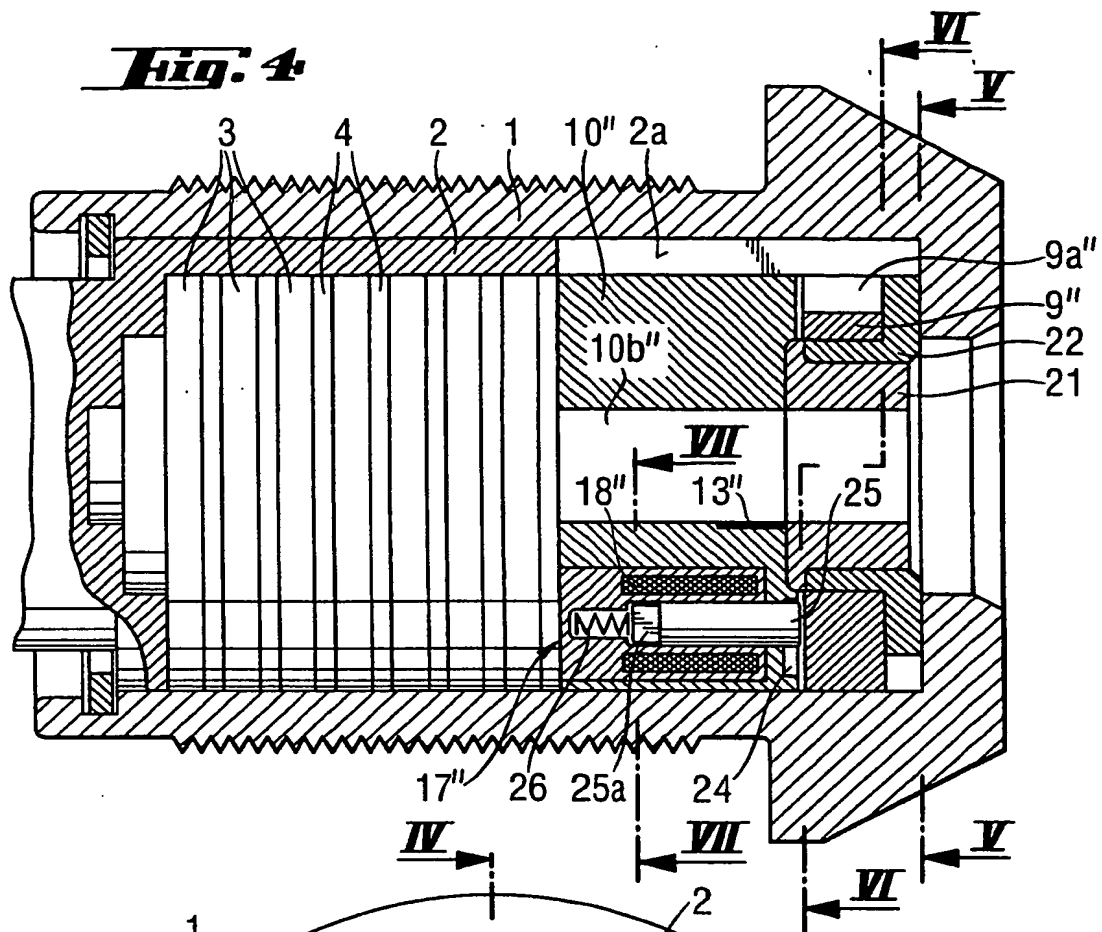


Fig. 5

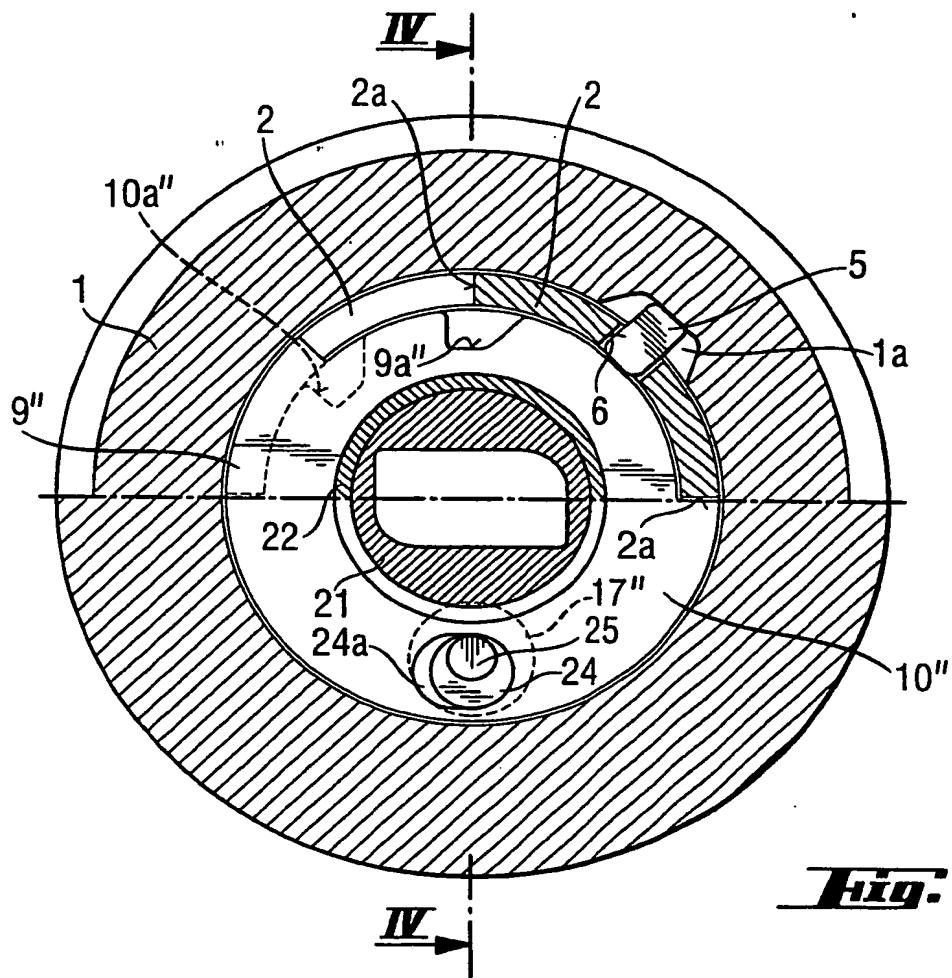


Fig. 6

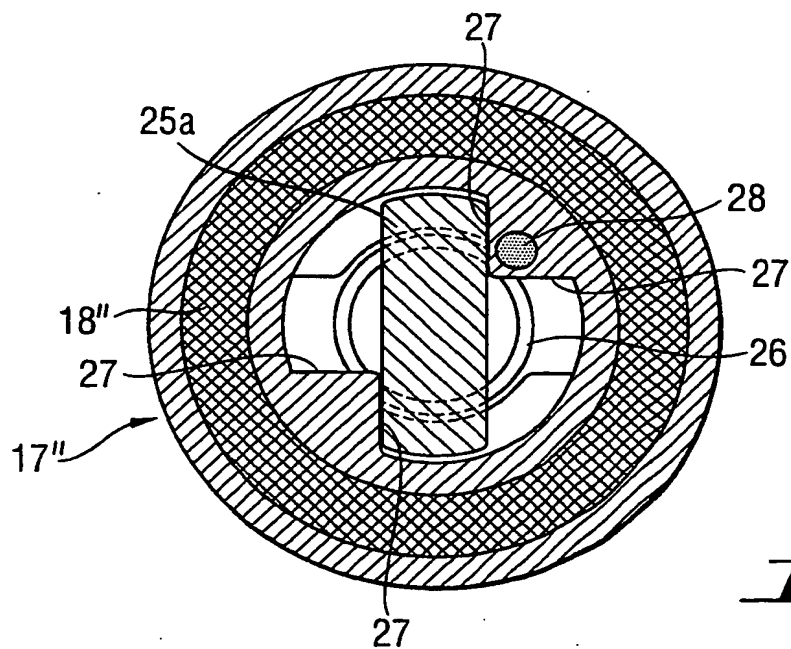


Fig. 7



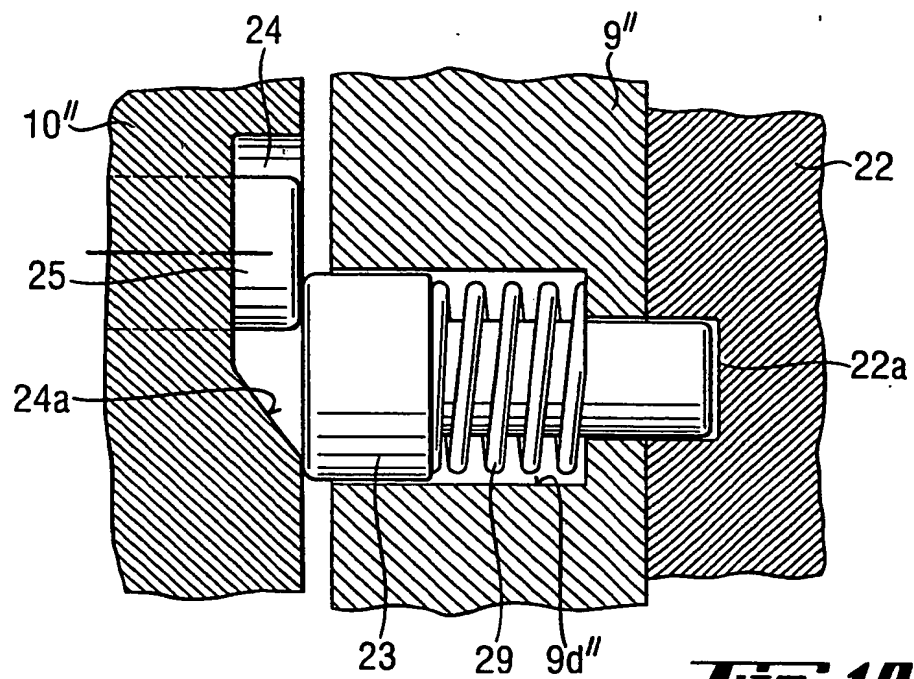


Fig. 10

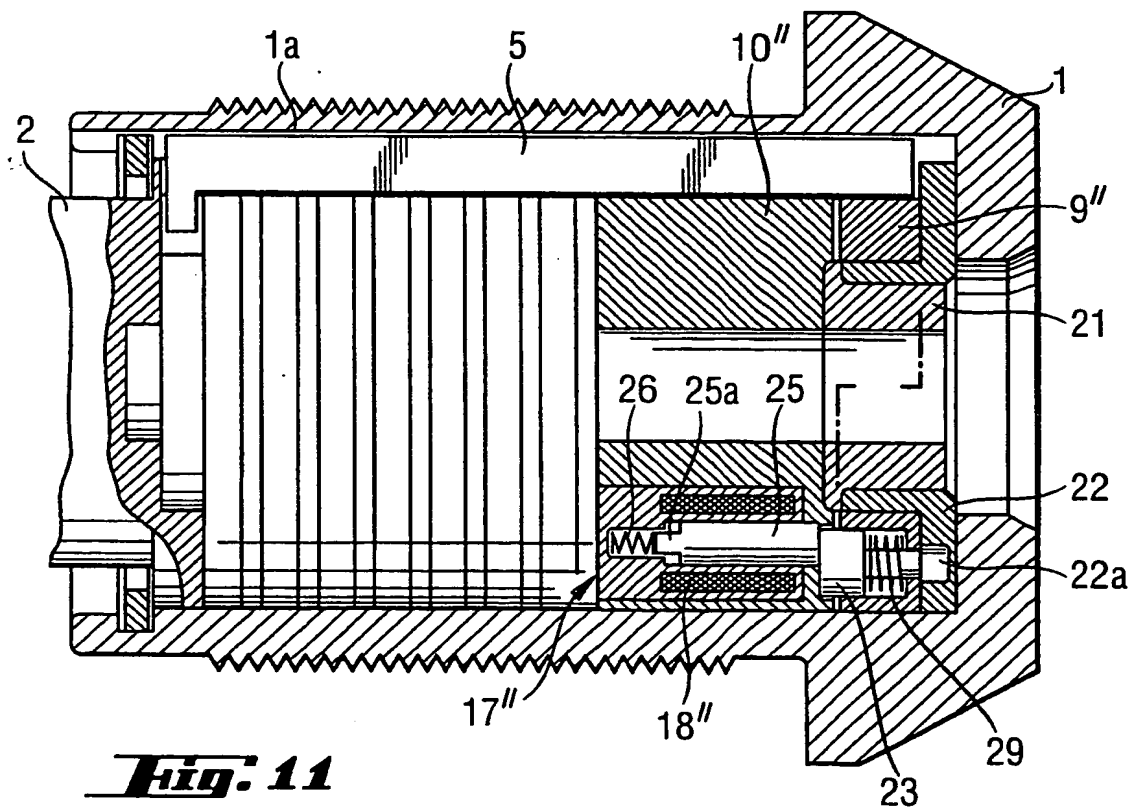


Fig. 11

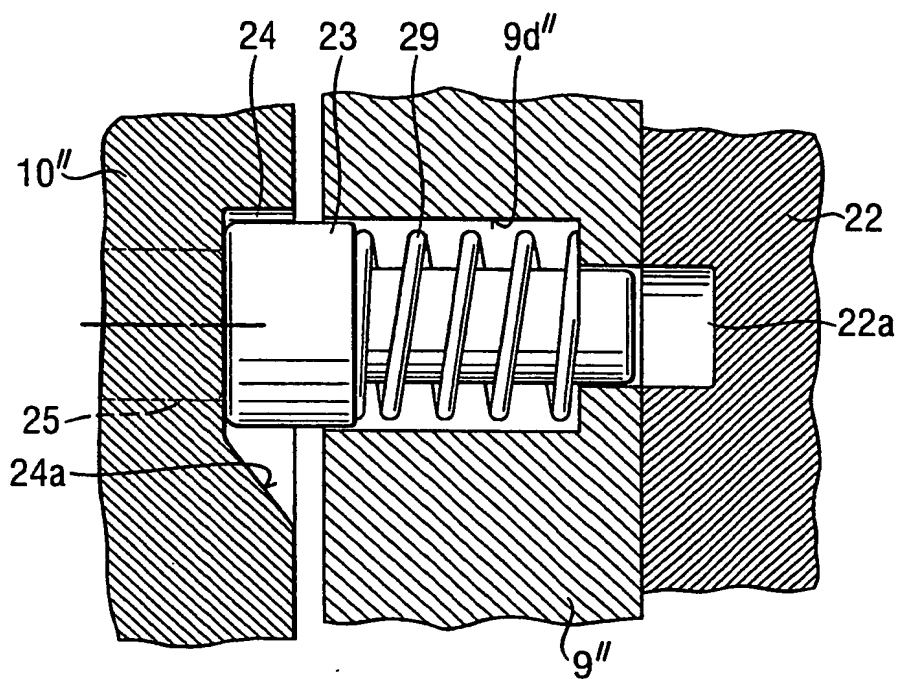


Fig. 12